



Conducting Discrimination Studies Involving Products with Batch-to-Batch Variability

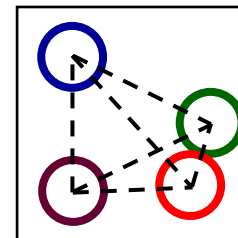
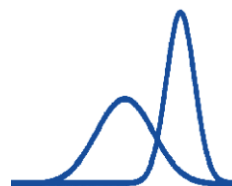
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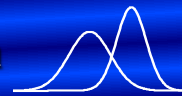
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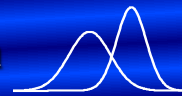
Issues in Discrimination testing

- Back-to-batch variability presents challenges for conducting similarity or difference testing between products
- No practical methodology is currently available
- Comparison of all possible variants of 2 products is possible but resource and time consuming



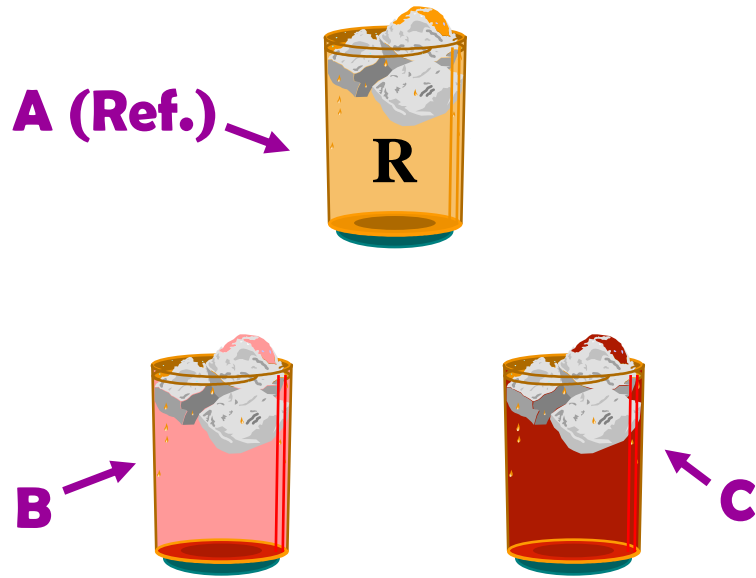
Issues in Discrimination testing

- This research: Investigated the Torgerson's method of triads as a way to overcome some of those difficulties
- Similar to the duo-trio test
- Study used non-carbonated orange drinks
- Compared Torgerson's method and duo-trio to corroborate their Thurstonian models
- Studied unidimensional and multidimensional models



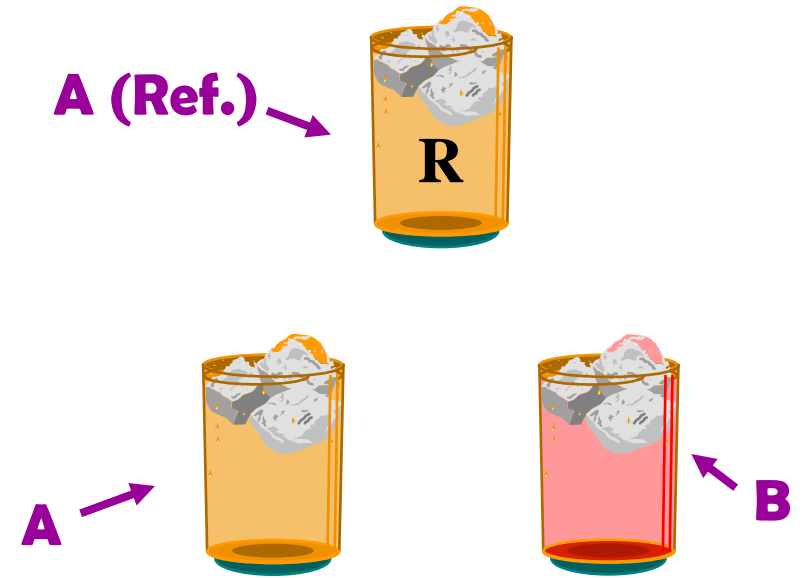
Protocols

Torgerson's Method



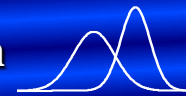
“Choose the stimulus (B or C) more similar to the reference (A)”

Duo-trio Method



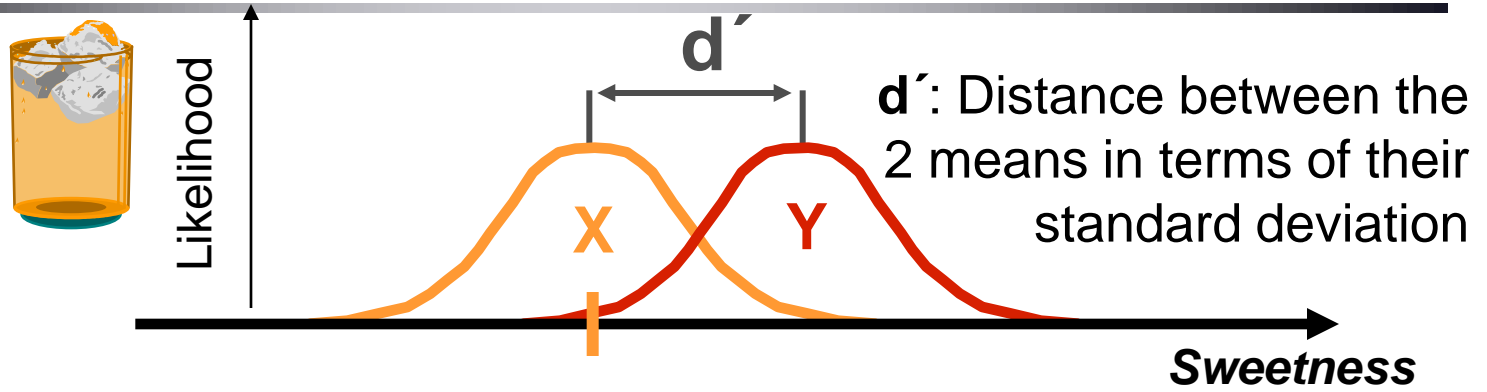
“Choose the stimulus (A or B) more similar to the reference (A)”

- Each protocol has a specific Thurstonian model



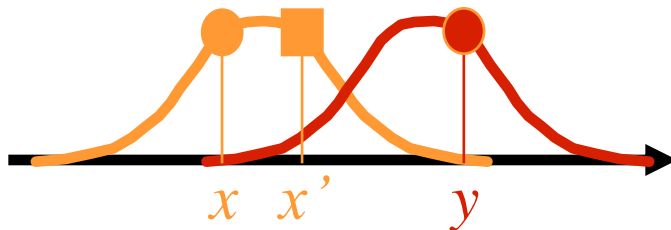
Ideas Behind Thurstonian Models

Variability



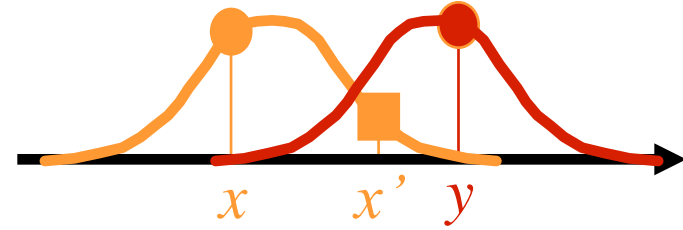
Decision rule

Duo-trio test :



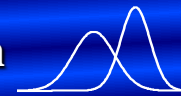
$$|x - x'| < |y - x'|$$

Correct

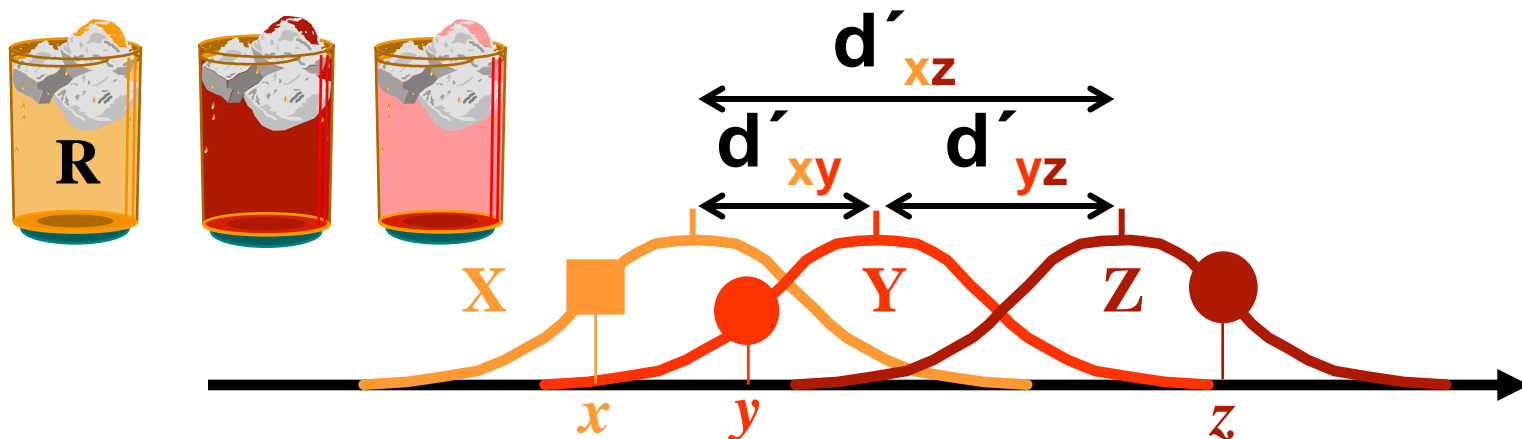


$$|x - x'| > |y - x'|$$

Incorrect

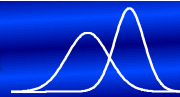


Thurstonian Model for Torgerson's Method



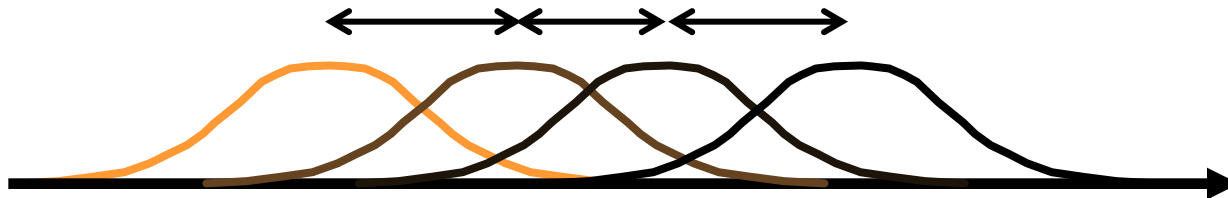
- In this example, y chosen as most similar to x; $x p_{yz}$
- Calculate $x p_{yz}$ $y p_{xz}$ $z p_{xy}$

- In this experiment, compared the Torgerson's method with duo-trio tests to validate its model
- Investigated the feasibility of Torgerson's method with food products



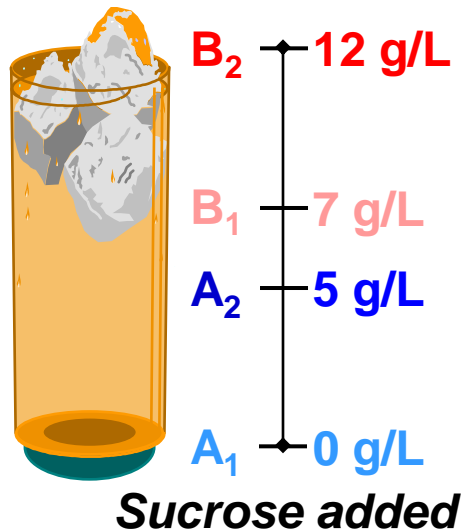


Experiment I



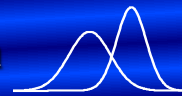
Experiment I: Experimental Design

- 18 subjects (3 M, 15 F; 18-54 yr.)
- Non carbonated orange beverage with added sucrose

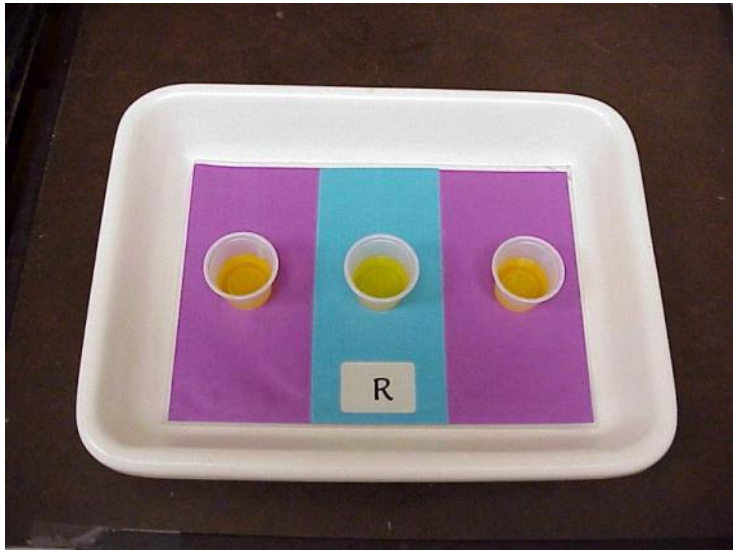


- A_1 and A_2 : two versions of “standard” product **A**
- B_1 and B_2 : two versions of “reformulated” product **B**

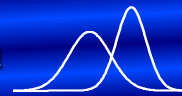
- 5 sessions (+1 training)
- Duo-trio comparisons: $A_1 B_1$, $A_2 B_2$



Experimental setting

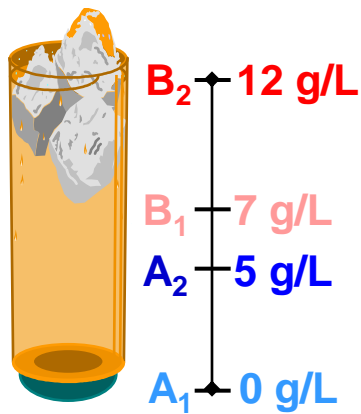


- Samples tested from left to right
- Reference in the middle
- A water rinse and primer sample taken before the actual triad



Experiment I: Results

Torgerson's method (*answers out of 36*)

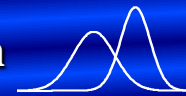


Triad	Answer
$A_1 P_{A_2 B_1}$	21
$A_1 P_{A_2 B_2}$	25
$A_1 P_{B_1 B_2}$	
$A_2 P_{A_1 B_1}$	15
$A_2 P_{A_1 B_2}$	22
$A_2 P_{B_1 B_2}$	

Triad	Answer
$B_1 P_{A_1 A_2}$	
$B_1 P_{A_1 B_2}$	12
$B_1 P_{A_2 B_2}$	24
$B_2 P_{A_1 A_2}$	
$B_2 P_{A_1 B_1}$	8
$B_2 P_{A_2 B_1}$	12

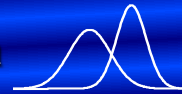
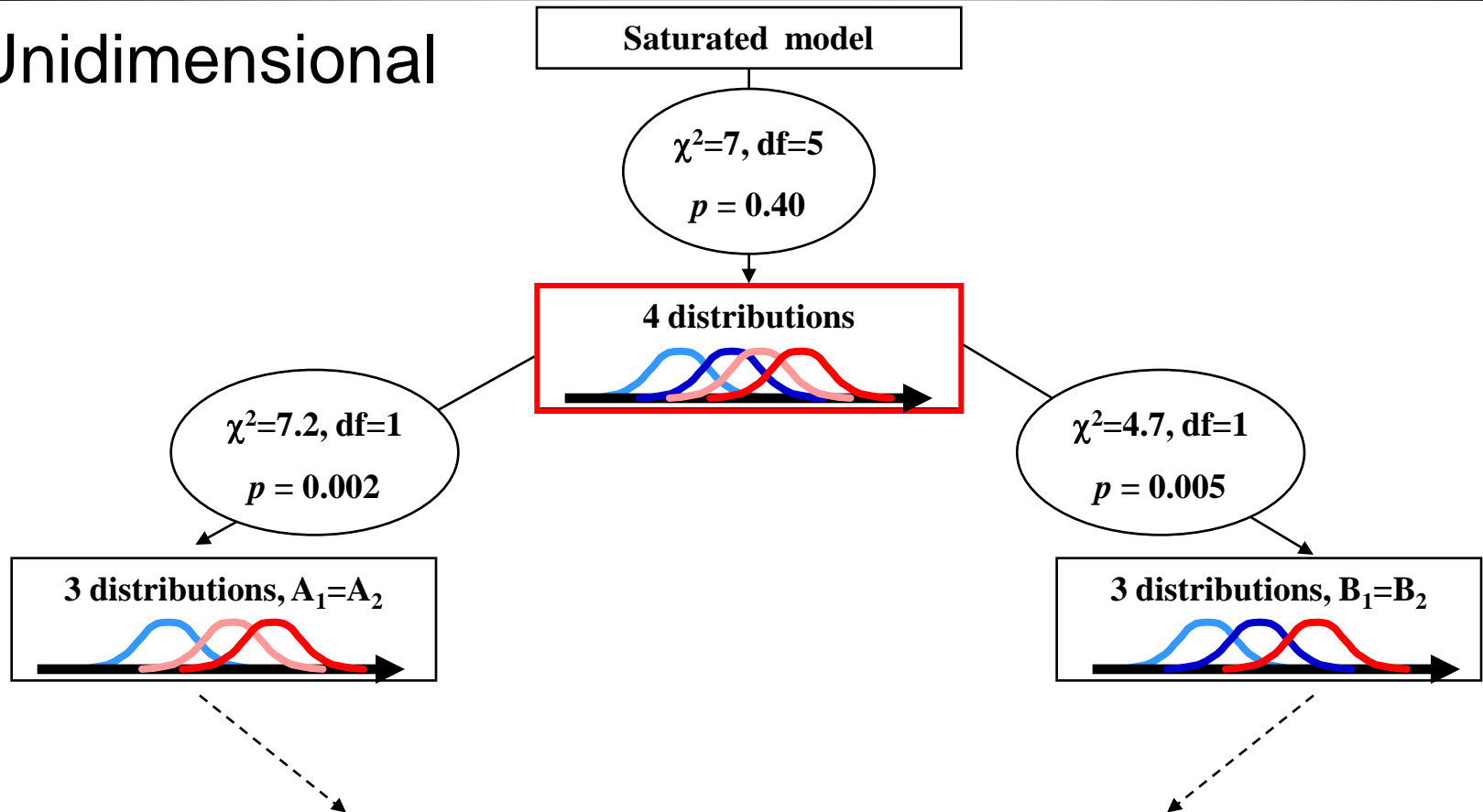
Duo-trio tests

Pair	# correct	Total # tests
$A_1 B_1$	190	288
$A_2 B_2$	191	288



Torgerson's method: Model fitting

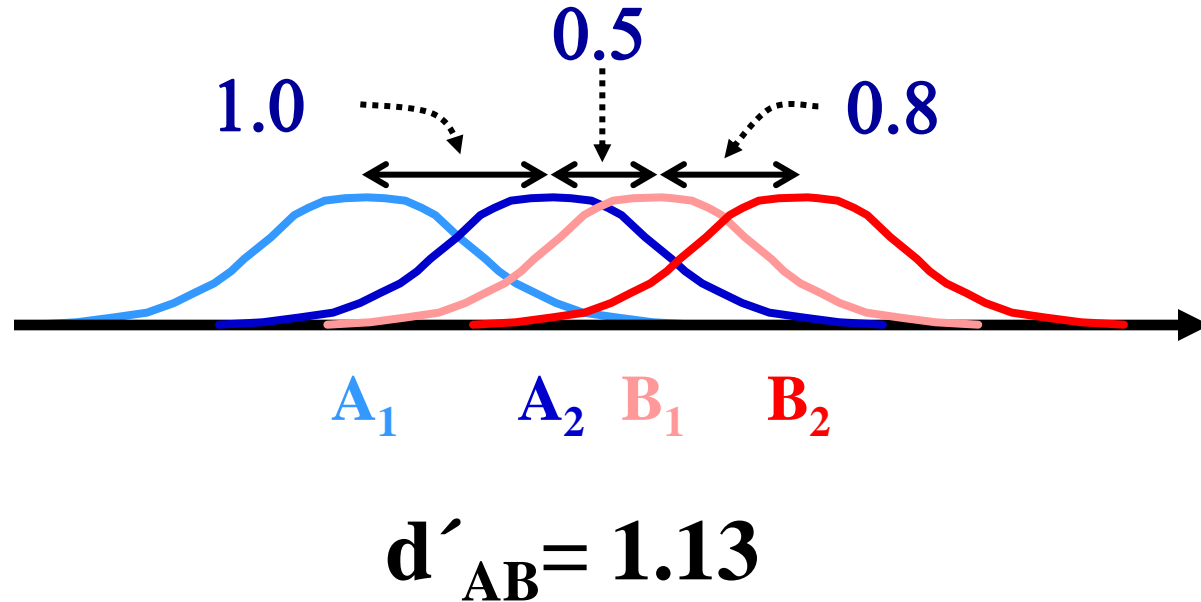
➤ Unidimensional



Results (ctd.)

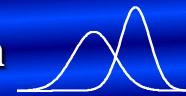
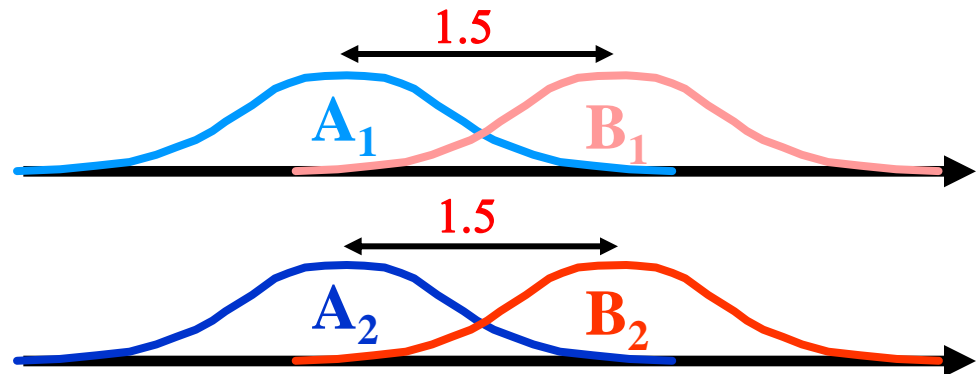
Torgerson's method

Pair	d'	Var. of d'
A_1A_2	1.0	0.08
A_1B_1	1.4	0.07
A_1B_2	2.3	0.11
A_2B_1	0.5	0.04
A_2B_2	1.3	0.07
B_1B_2	0.8	0.07



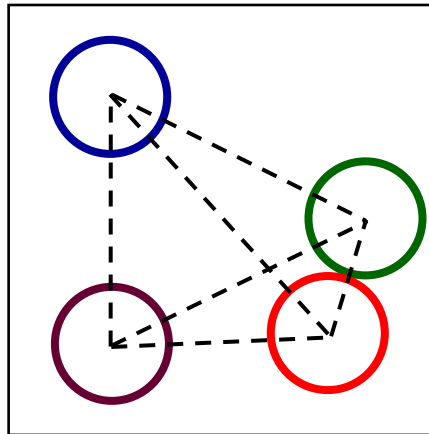
Duo-trio test

Pair	d'	Var. of d'
A_1B_1	1.5	0.03
A_2B_2	1.5	0.03



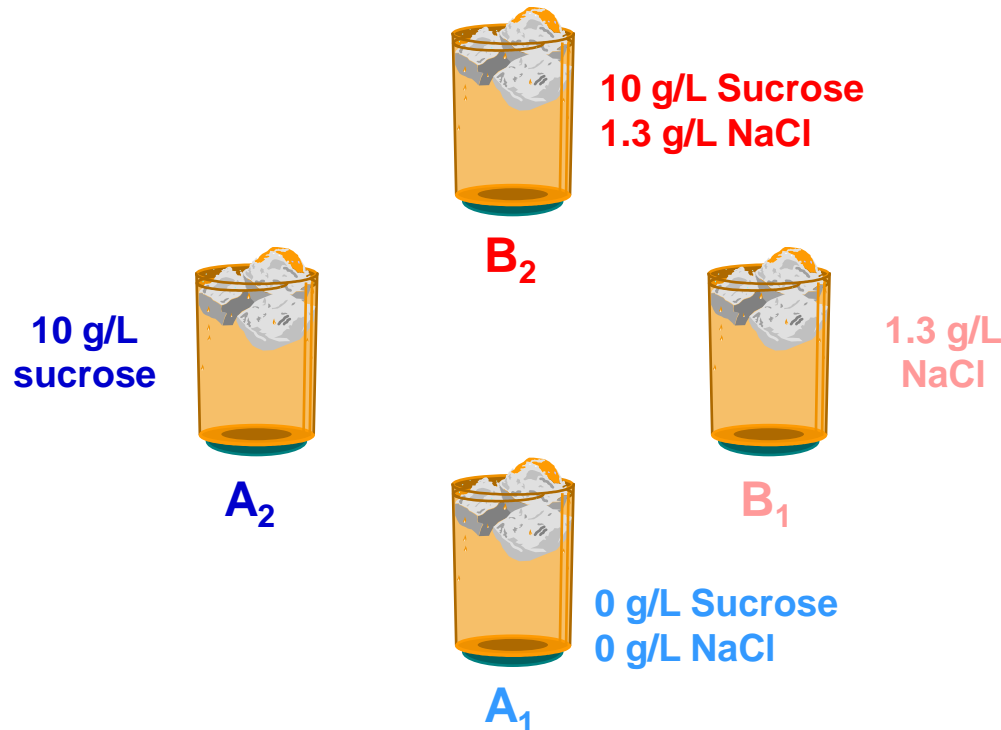


Experiment II



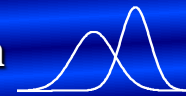
Experiment II: Experimental Design

- 24 subjects (6 M, 18 F; 18-27 yr.)
- Non carbonated orange beverage with additive

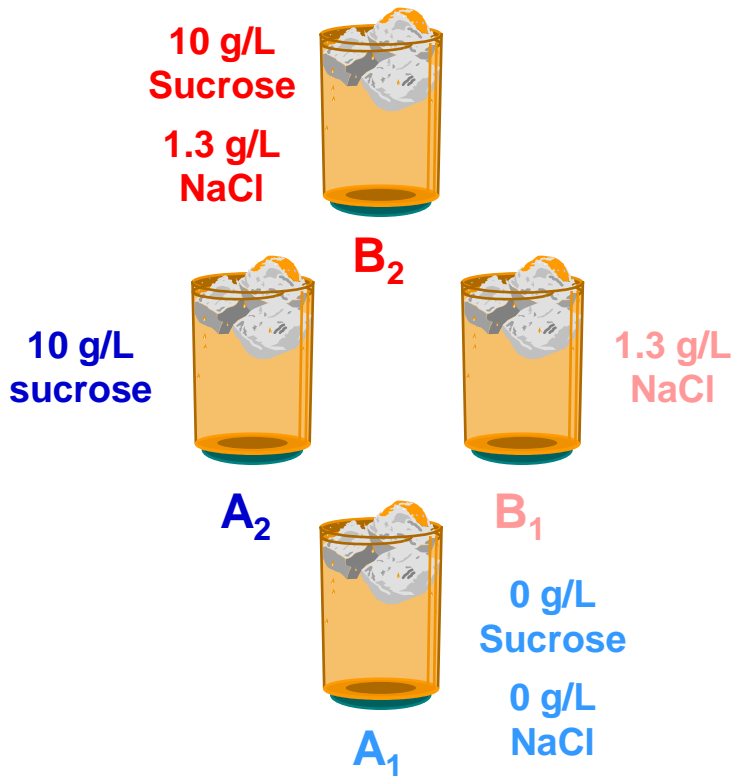


- **A₁** and **A₂**: two versions of “standard” product **A**
- **B₁** and **B₂**: two versions of “reformulated” product **B**

- 5 sessions (+1 training)
- Duo-trio comparisons: **A₁A₂**, **A₁B₁**, **A₁B₂**



Experiment II: Results



Torgerson's method (answers / 48)

Triad	Answer
$A_1 P_{A_2 B_1}$	19
$A_1 P_{A_2 B_2}$	22
$A_1 P_{B_1 B_2}$	32
$A_2 P_{A_1 B_1}$	30
$A_2 P_{A_1 B_2}$	27
$A_2 P_{B_1 B_2}$	15

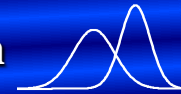
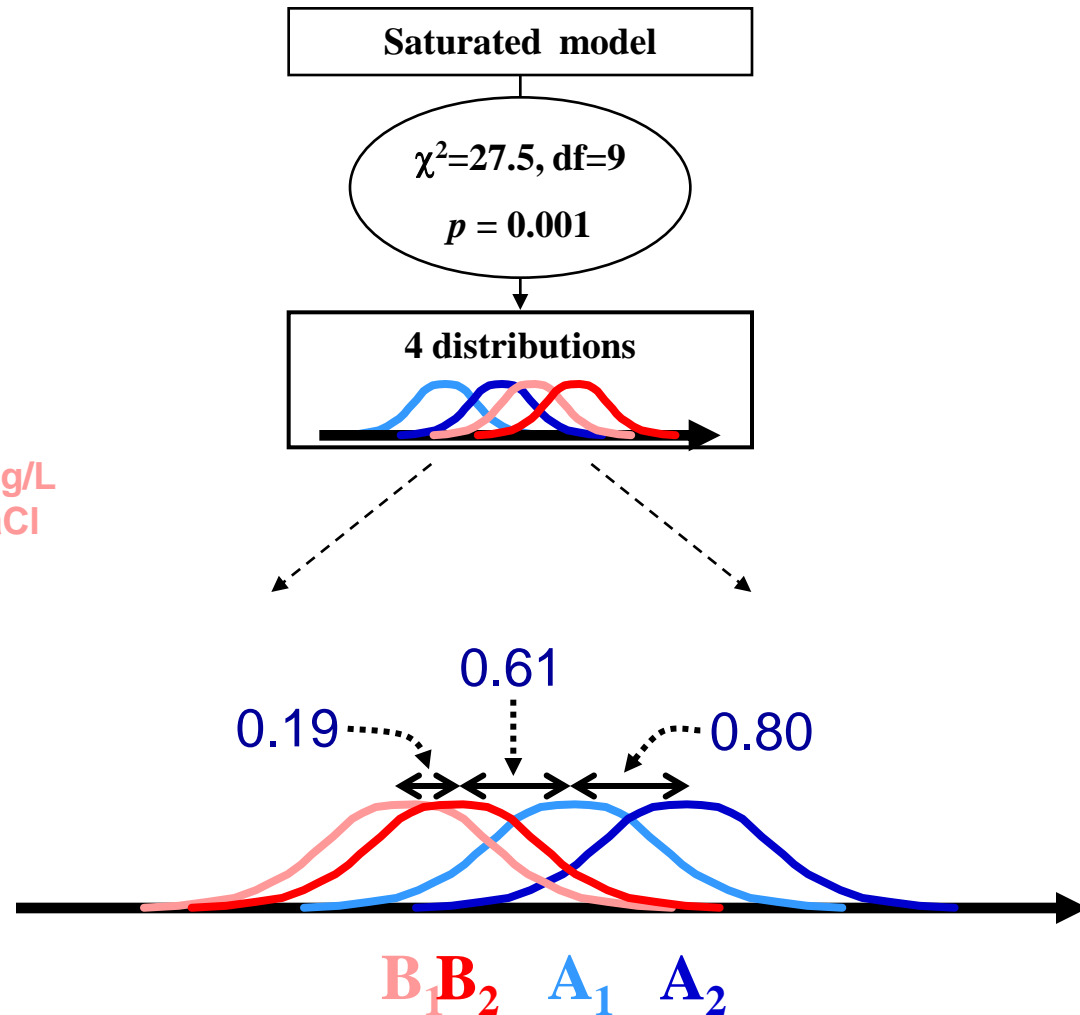
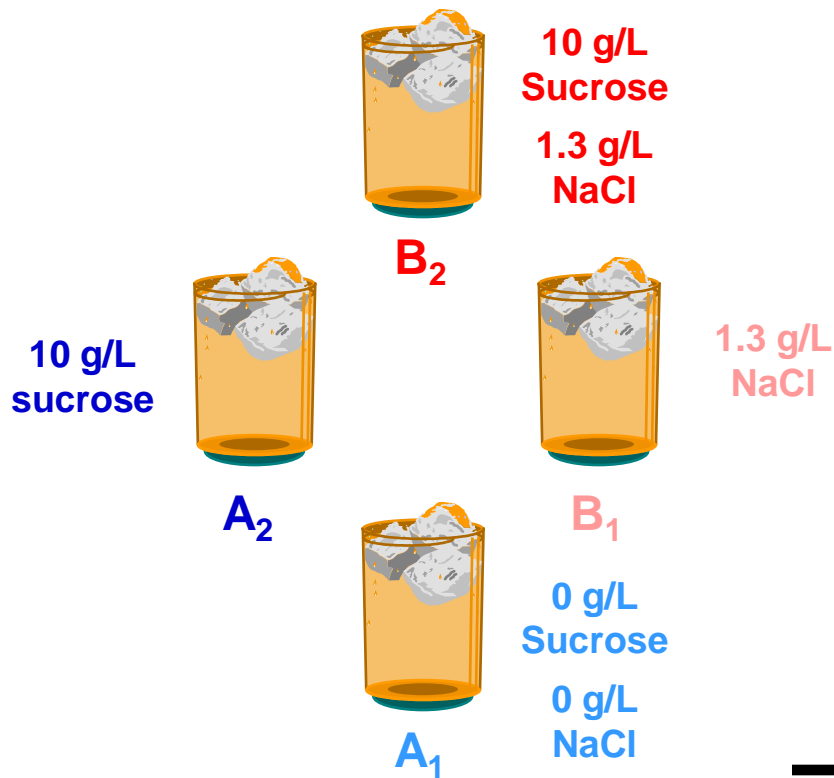
Triad	Answer
$B_1 P_{A_1 A_2}$	30
$B_1 P_{A_1 B_2}$	18
$B_1 P_{A_2 B_2}$	13
$B_2 P_{A_1 A_2}$	22
$B_2 P_{A_1 B_1}$	14
$B_2 P_{A_2 B_1}$	16

Duo-trio tests

Pair	# correct	Total # tests
$A_1 A_2$	200	288
$A_1 B_1$	208	288
$A_1 B_2$	226	288

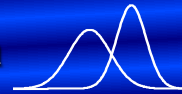
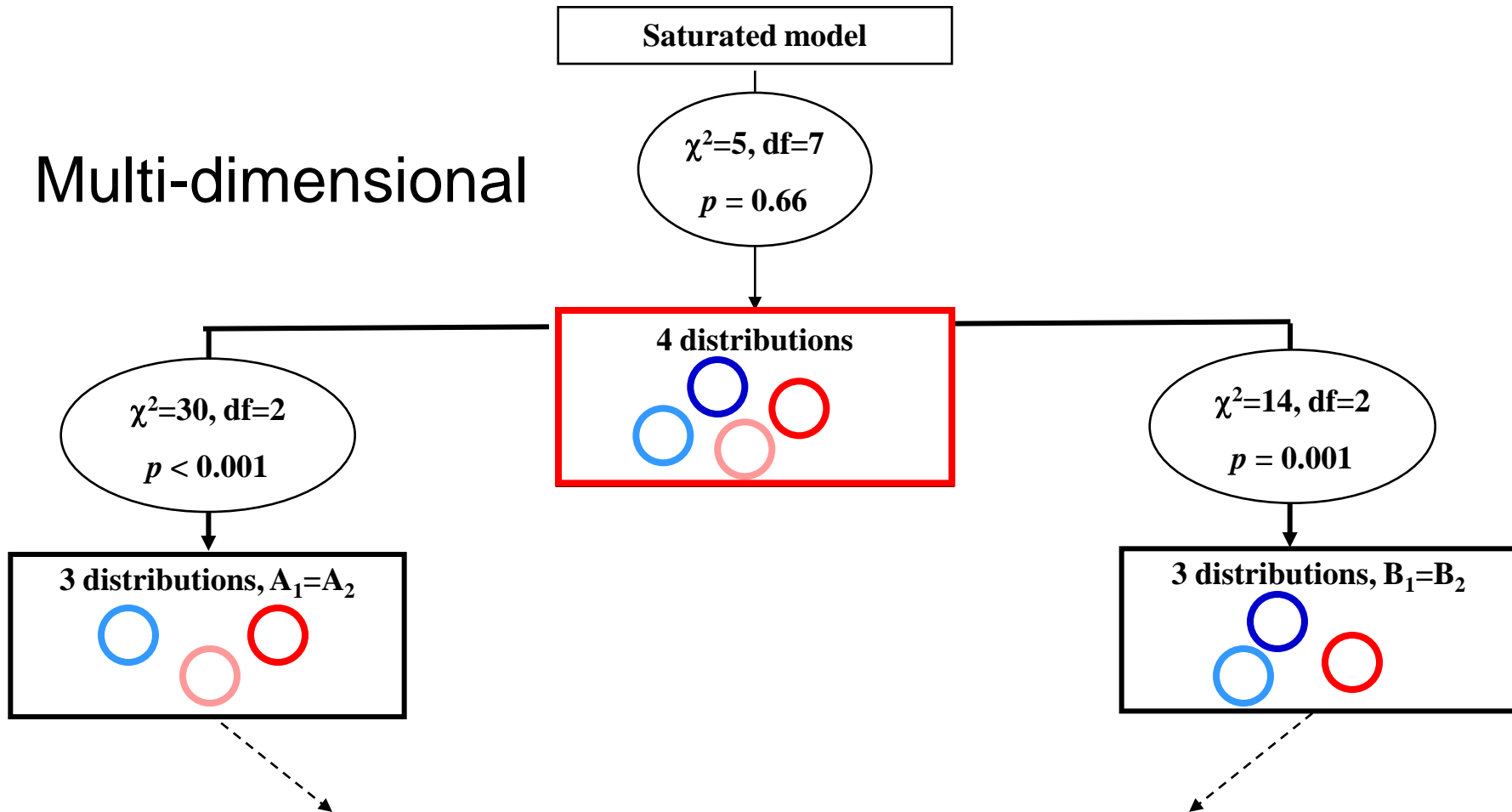
Model fitting

➤ Unidimensional



Model fitting

➤ Multi-dimensional

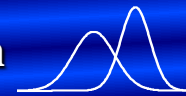
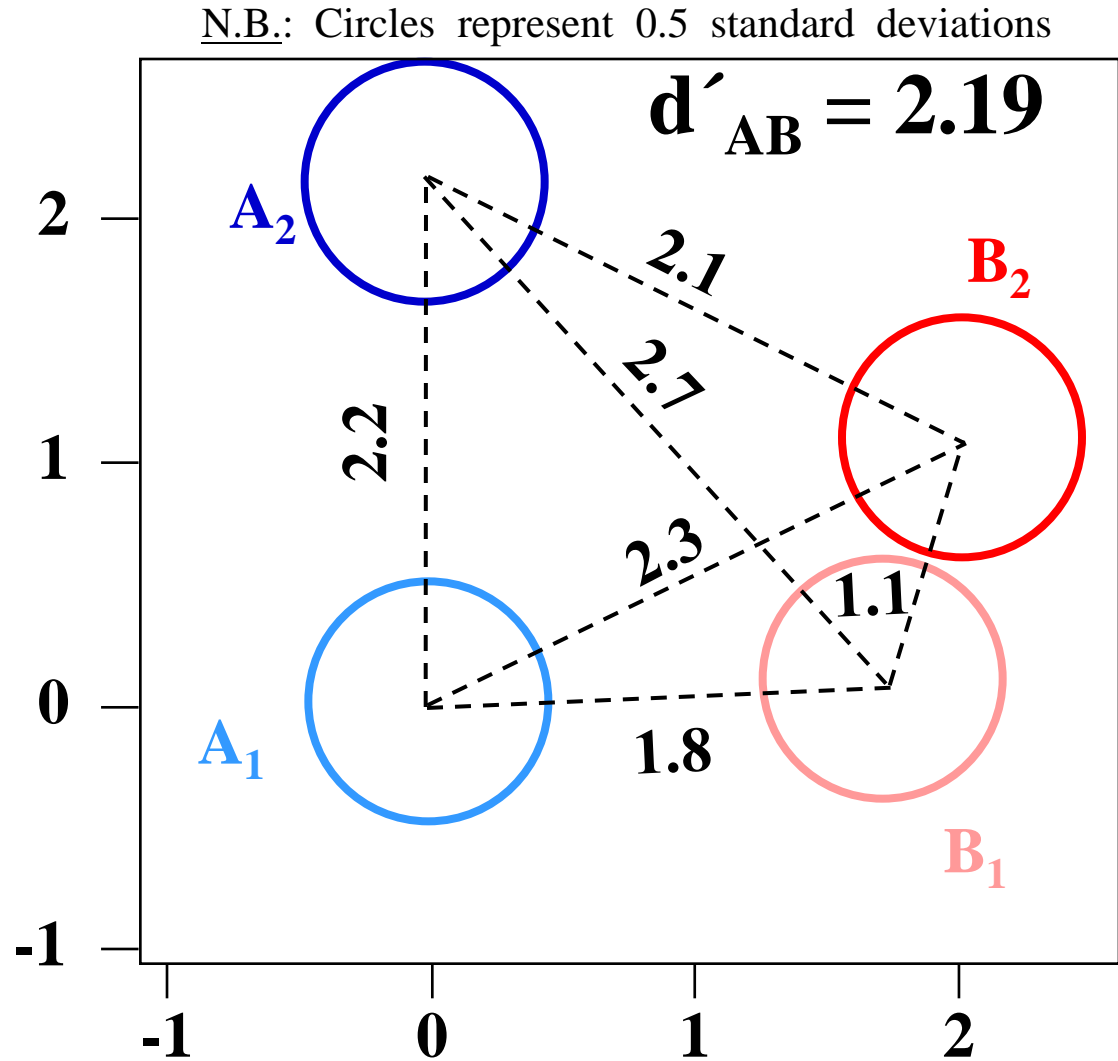


➤ Results...

Pair	d'	σ^2
A_1A_2	2.2	0.08
A_1B_1	1.8	0.07
B_1B_2	1.1	0.07
A_1B_2	2.3	0.11
A_2B_1	2.7	0.09
A_2B_2	2.1	0.07

Duo-trio test

Pair	d'	σ^2
A_1A_2	1.7	0.03
A_1B_1	1.9	0.03
A_1B_2	2.3	0.03





Conclusions



- Suitability of Thurstonian model for the Torgerson's method has been confirmed
- Torgerson's method permits the estimation of several d' values simultaneously (# of stimuli unlimited)
- It is slightly more powerful and a lot less time and resource consuming than the corresponding duo-trio tests
- It presents very attractive applications when studying differences among products with batch-to-batch variability

